



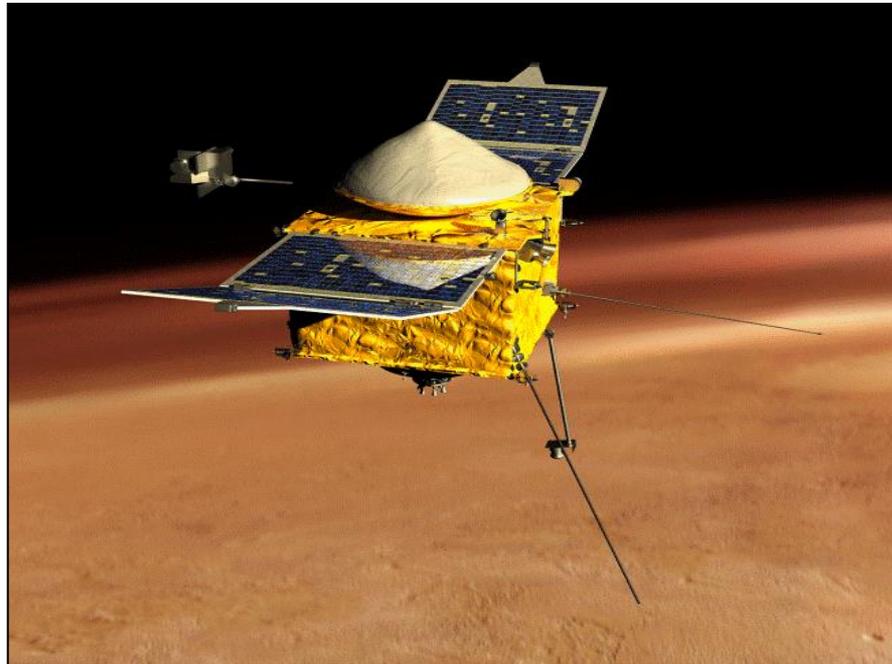
The 2013 MAVEN Mission To Mars



Summary of MAVEN Status

- We've been developing MAVEN since 2003
- All science instruments are complete and on the spacecraft
- Spacecraft assembly is complete, environmental testing is complete, observatory is at Cape Canaveral in final preparation for launch
- Launch period is 18 November – 7 December, 2013
- Arrival at Mars in September, 2014
- One-Earth-year primary science mission

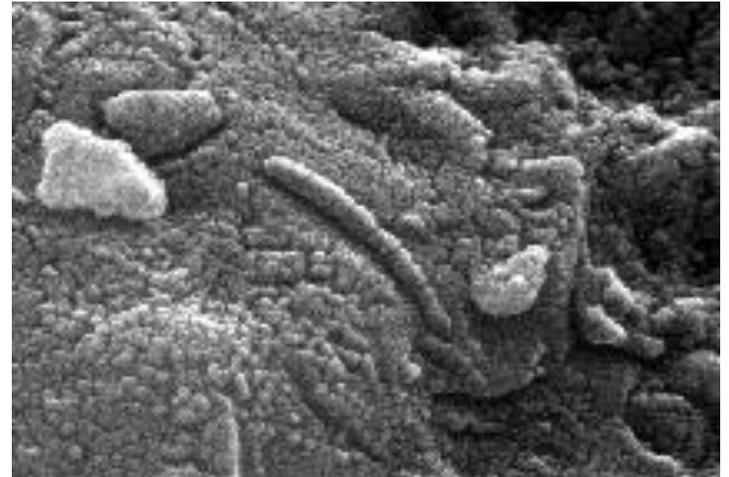
Technical progress is on track, we are on schedule and on budget!



Overarching Question: Did Mars Ever Have Life?

Mars appears to meet or have met all of the environmental requirements for the occurrence of life:

- Liquid water
- Access to the biogenic elements
- Source of energy to drive metabolism



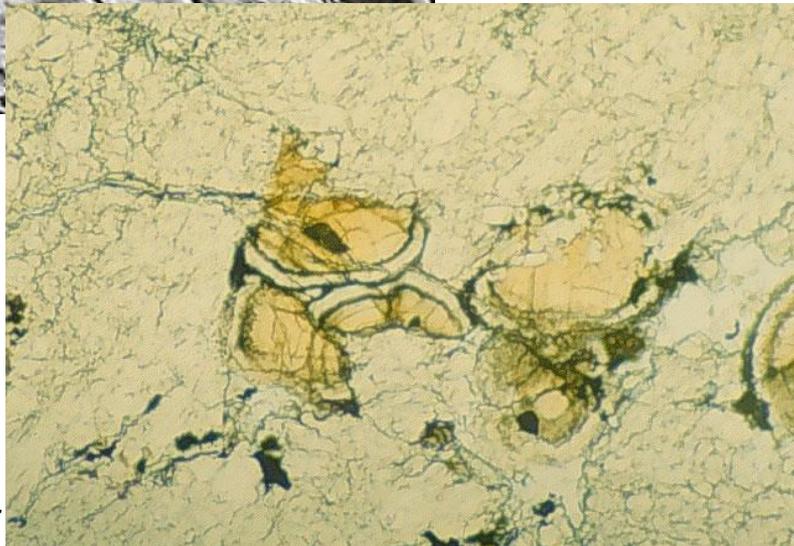
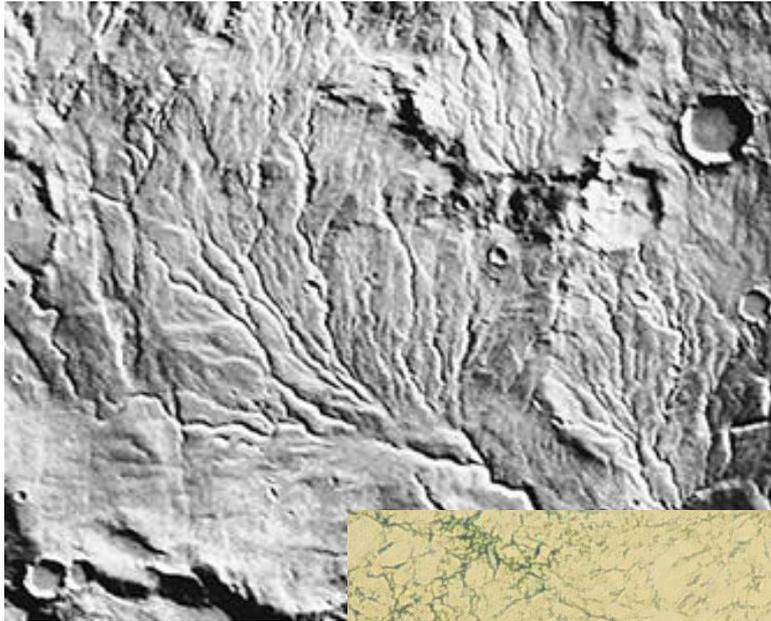
Did Mars ever have life?

How did any life interact with its planetary environment?

How has the habitability of Mars changed over time?

Where Did The Water Go? Where Did The CO₂ Go?

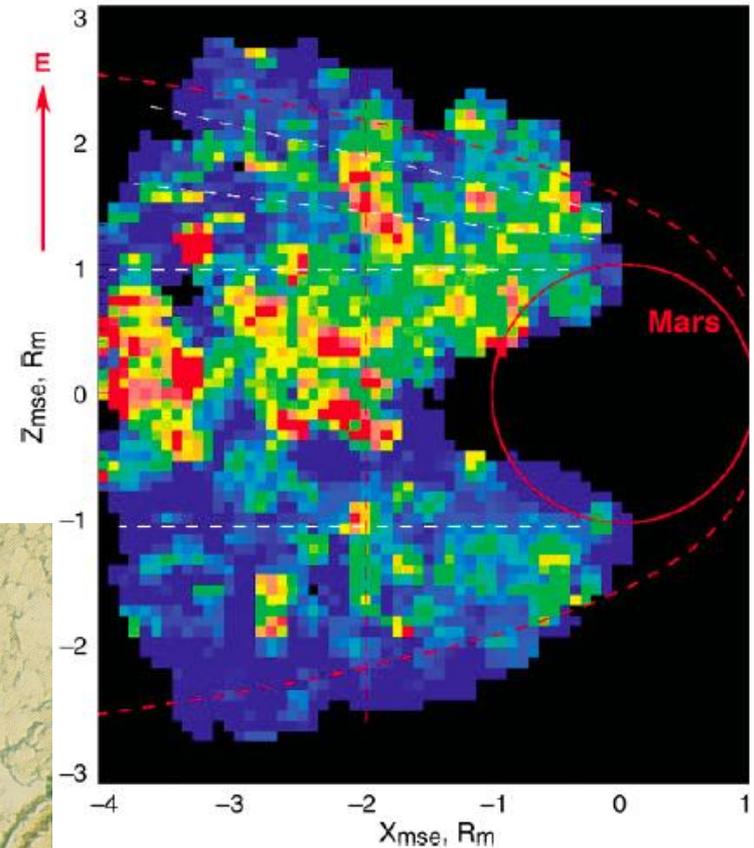
Abundant evidence for ancient water



Volatiles can go into the crust

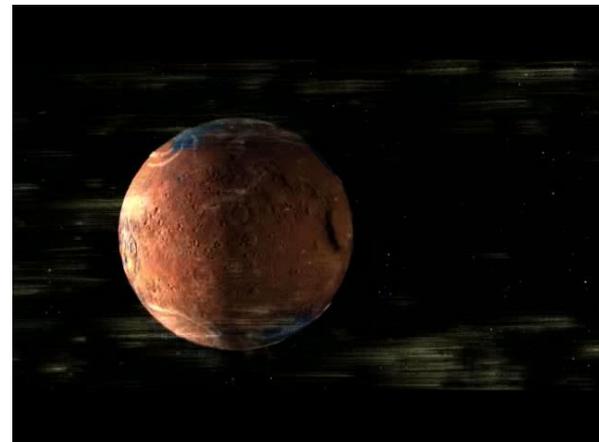
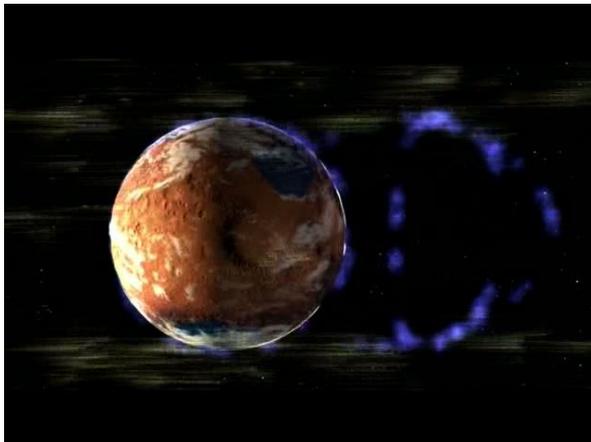
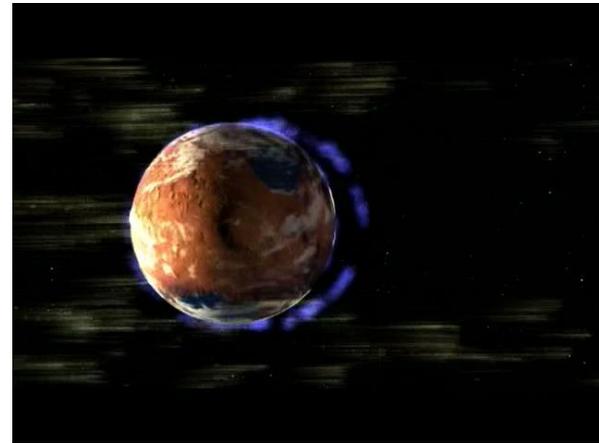
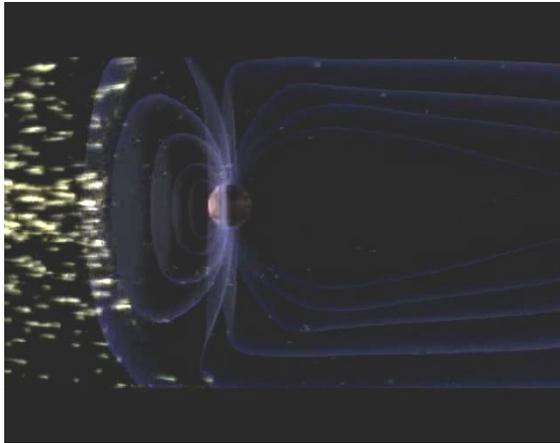
Carbonate deposits in a Martian meteorite

Volatiles can be lost to space



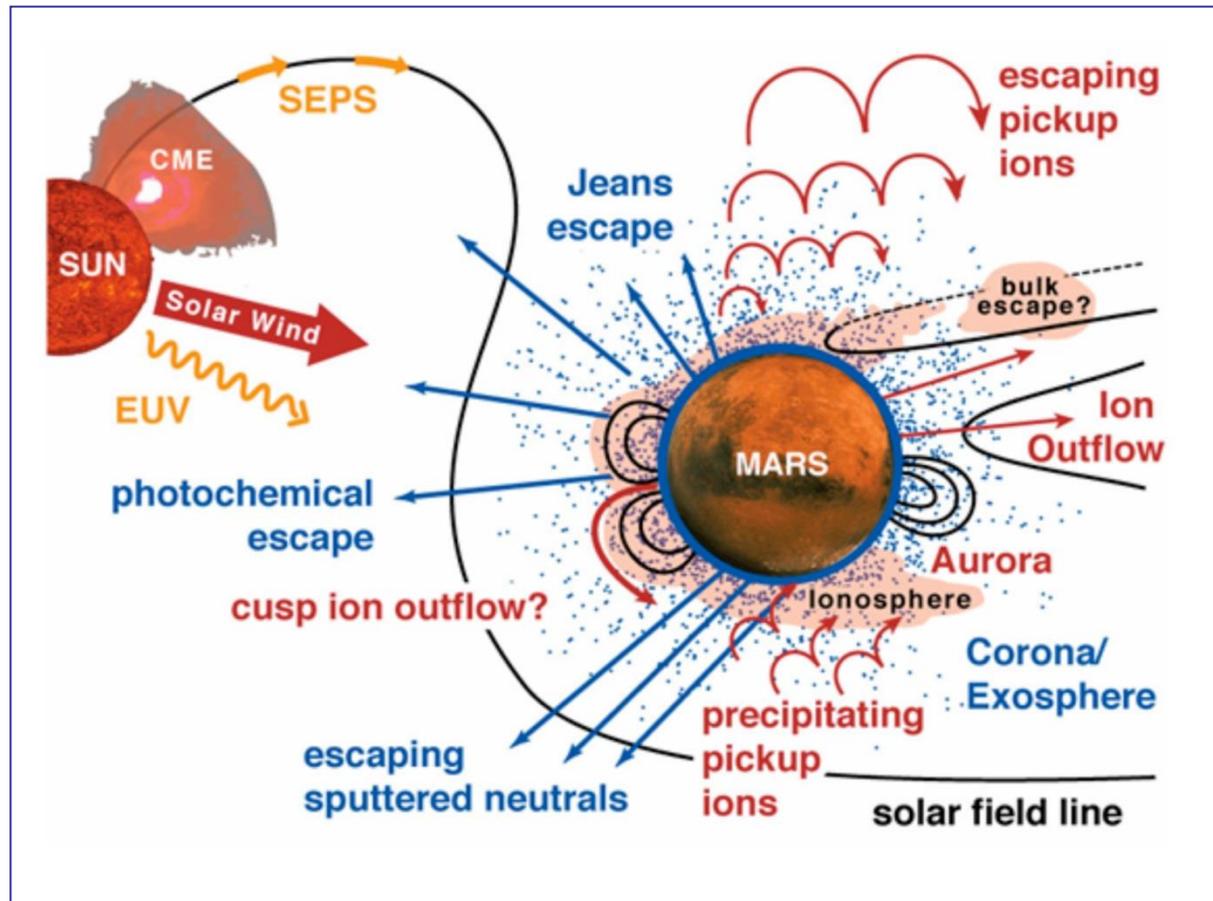
Escaping ions detected from Mars Express

Working Scenario For Key Process In Evolution Of Martian Atmosphere



Turn-off of the Martian magnetic field allowed turn-on of solar-EUV and solar-wind stripping of the atmosphere approximately 4.0 billion years ago, resulting in the present thin, cold atmosphere.

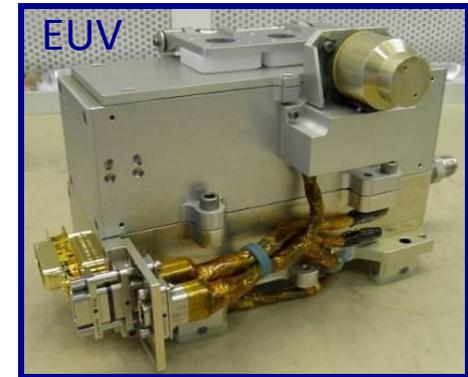
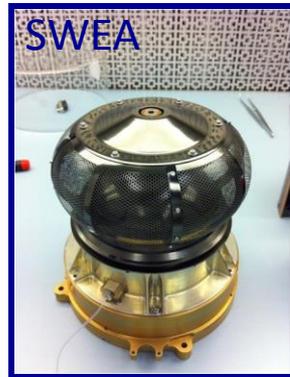
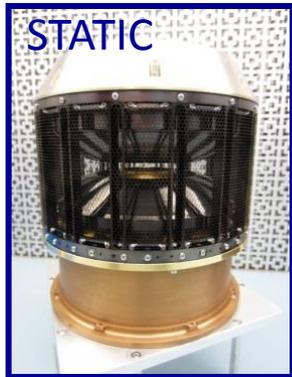
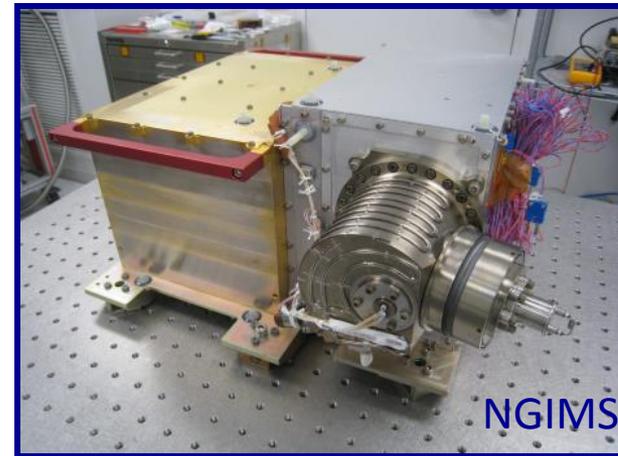
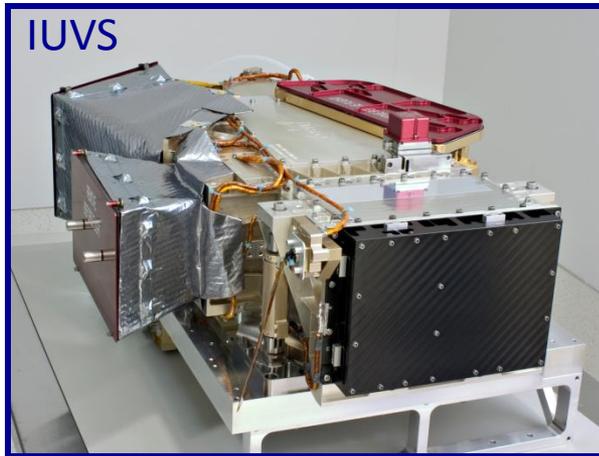
MAVEN Will Allow Us To Understand Escape Of Atmospheric Gases To Space



- MAVEN will determine the present state of the upper atmosphere and today's rates of loss to space.

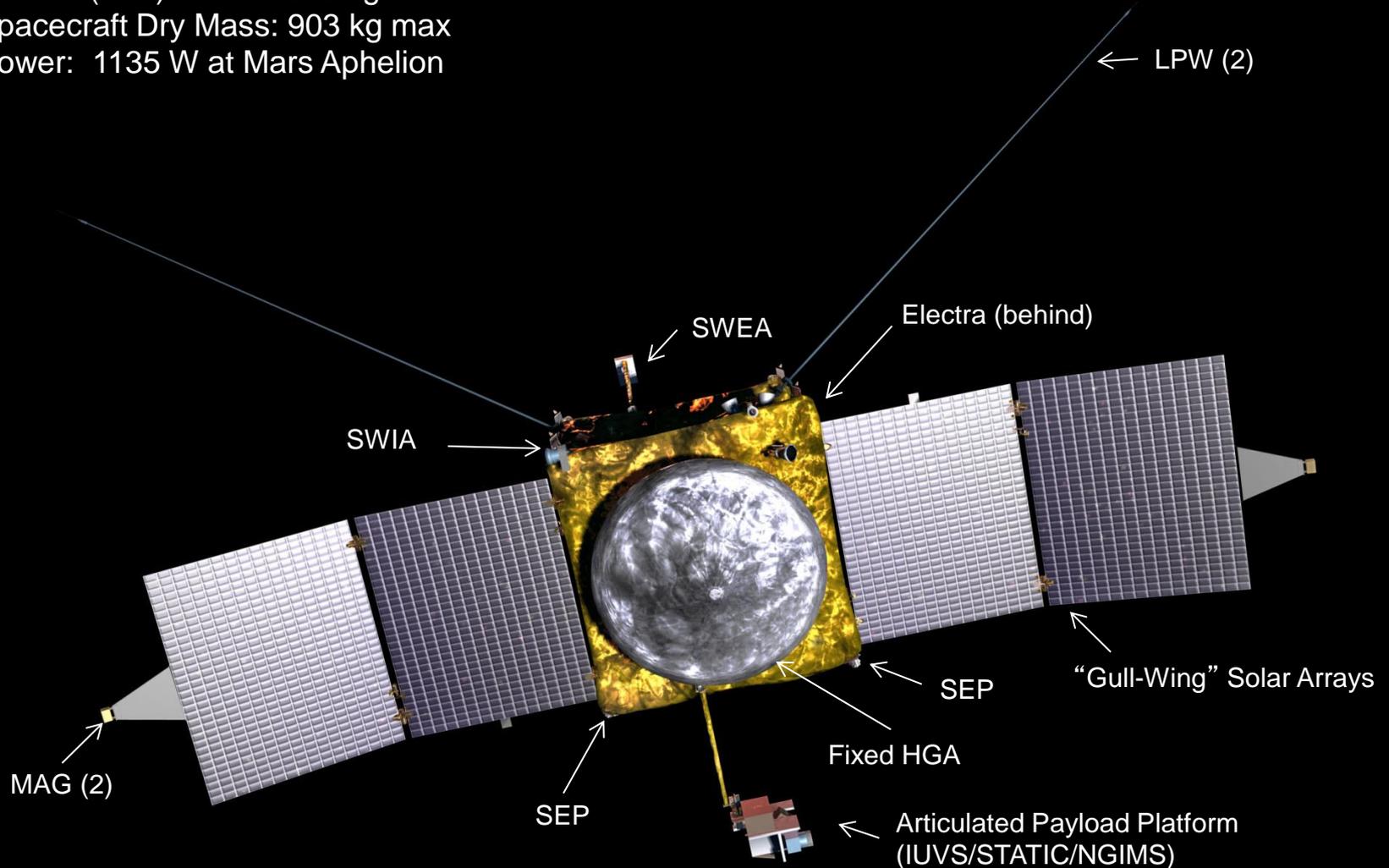
- Measurements will allow determination of the net integrated loss to space through time.

The MAVEN Science Instruments

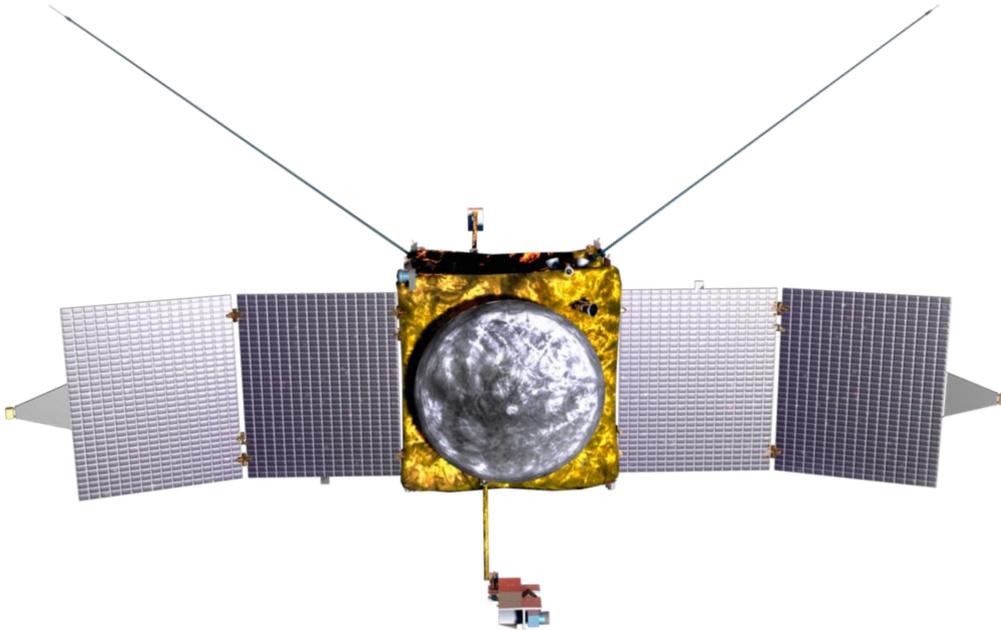


The MAVEN Spacecraft

- Launch (Wet) Mass: 2550 kg max
- Spacecraft Dry Mass: 903 kg max
- Power: 1135 W at Mars Aphelion



The MAVEN Spacecraft



Same weight fully loaded as a GMC Yukon – 2550 kg.



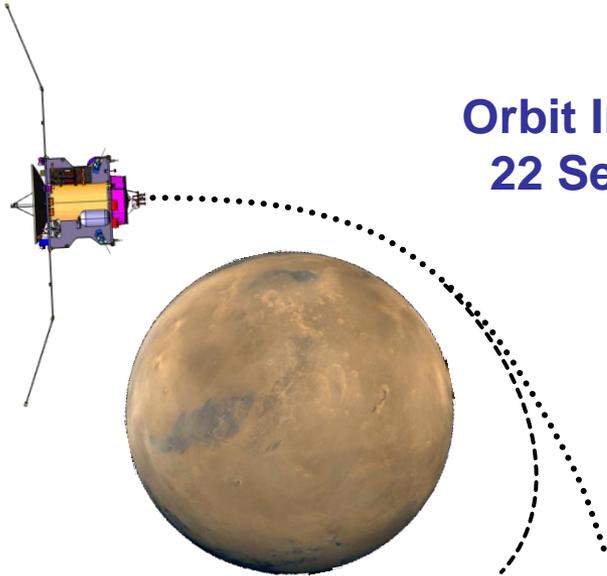
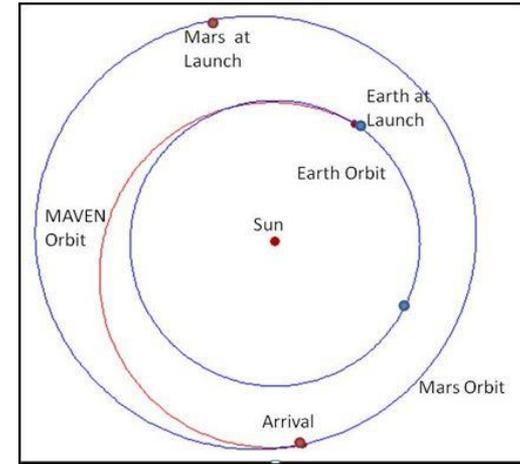
Same length as a school bus – wingtip-to-wingtip length of 37ft.

MAVEN Mission Architecture



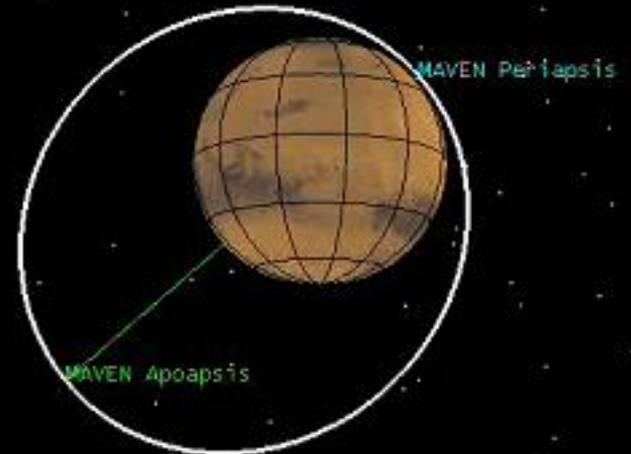
**20-Day Launch Period:
November 18 –
December 7, 2013**

Ten-Month Ballistic Cruise to Mars



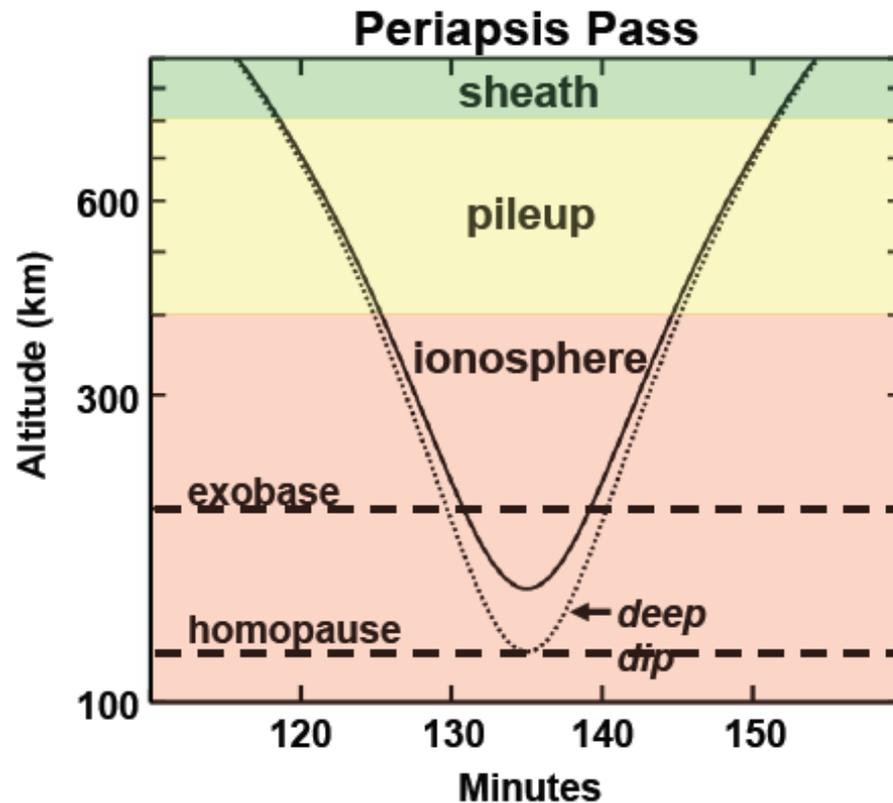
**Orbit Insertion:
22 Sept 2014**

One Year of Science Operations



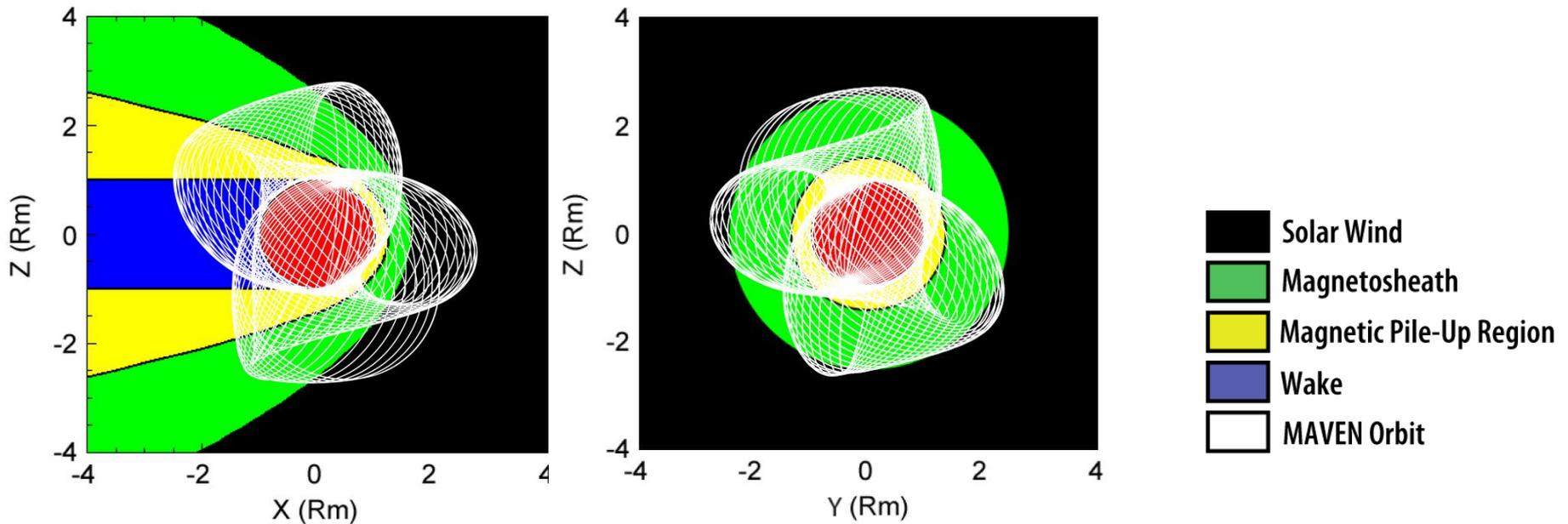
Elliptical Orbit Allows Measurement of All Relevant Regions of Upper Atmosphere

- Nominal periapsis near 150 km.
- Five “deep-dip” campaigns with periapsis near 125 km.
- Provide complete coverage of entire upper atmosphere



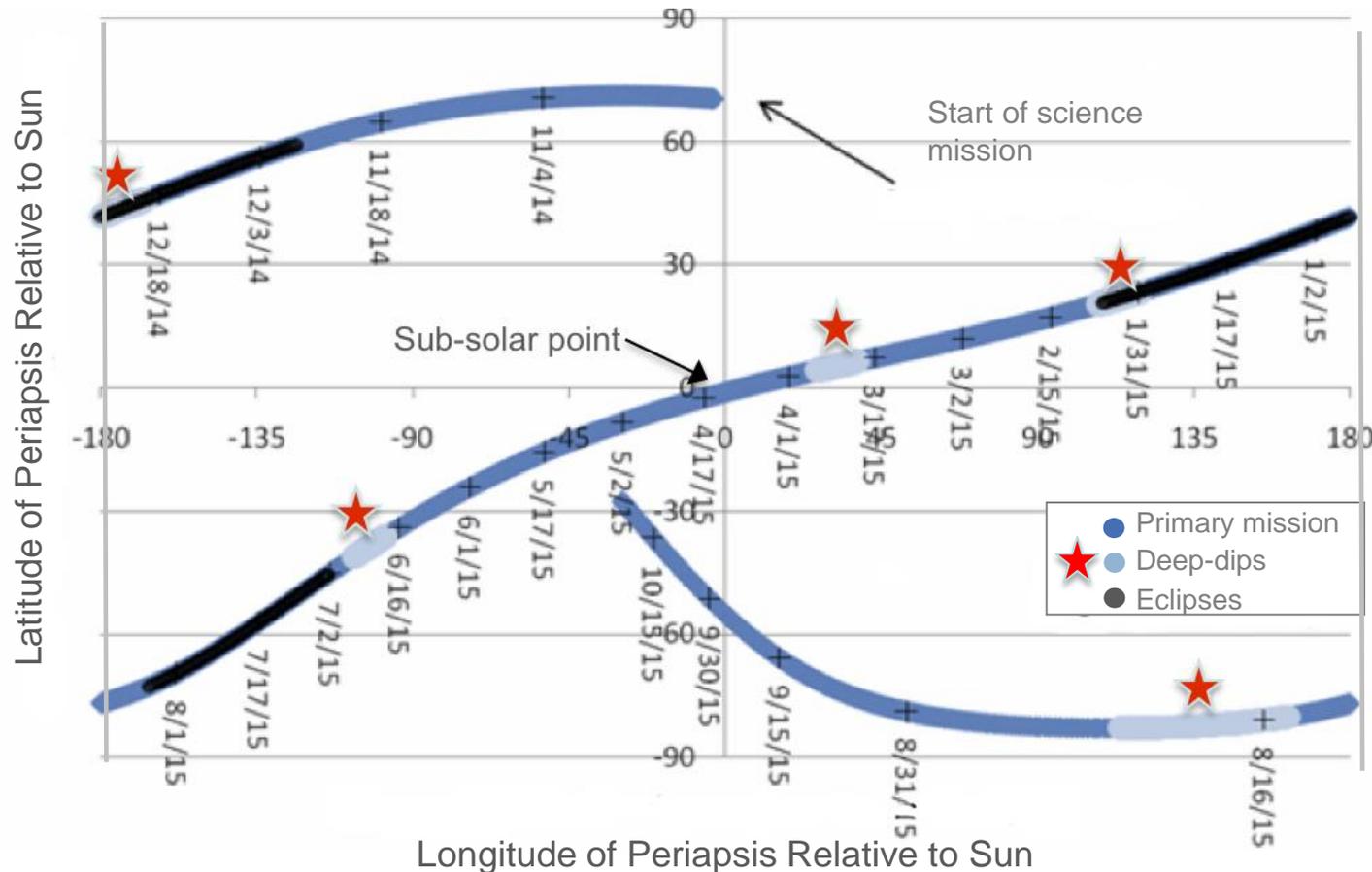
MAVEN Orbit and Primary Science Mission

- Elliptical orbit to provide coverage of all altitudes
- The orbit precesses in both latitude and local solar time
- One-Earth-year mission allows thorough coverage of near-Mars space

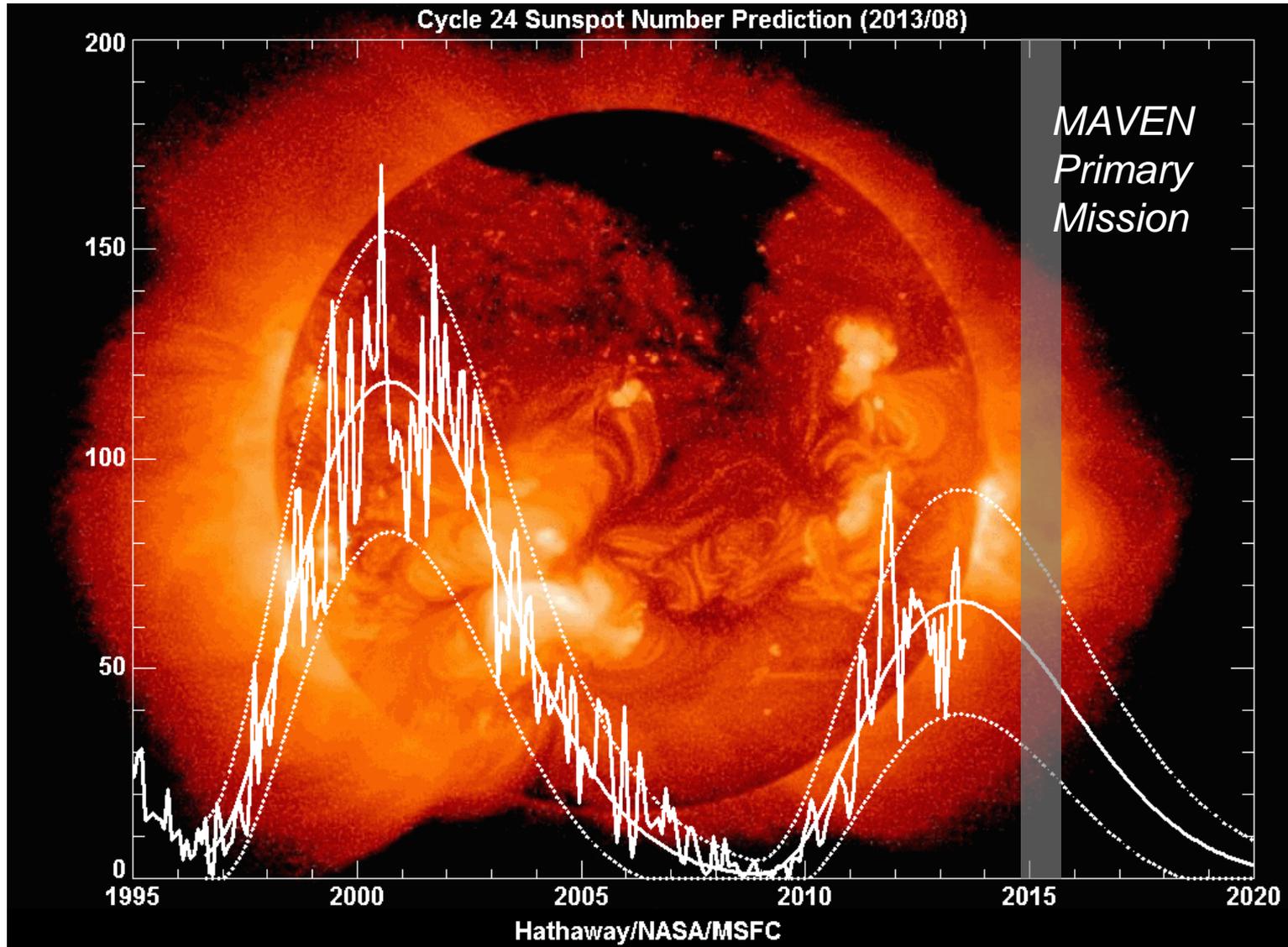


Latitude and Local Time Coverage

- One-Earth-year mission provides coverage of all local solar times and most latitudes.
- Figure shows periapsis location for each orbit.
- Deep dips near subsolar region, midnight, terminator, crustal B region, polar cap



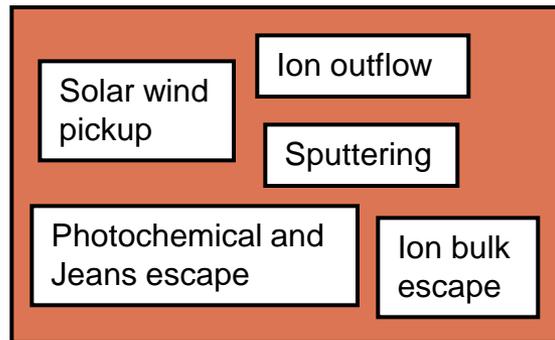
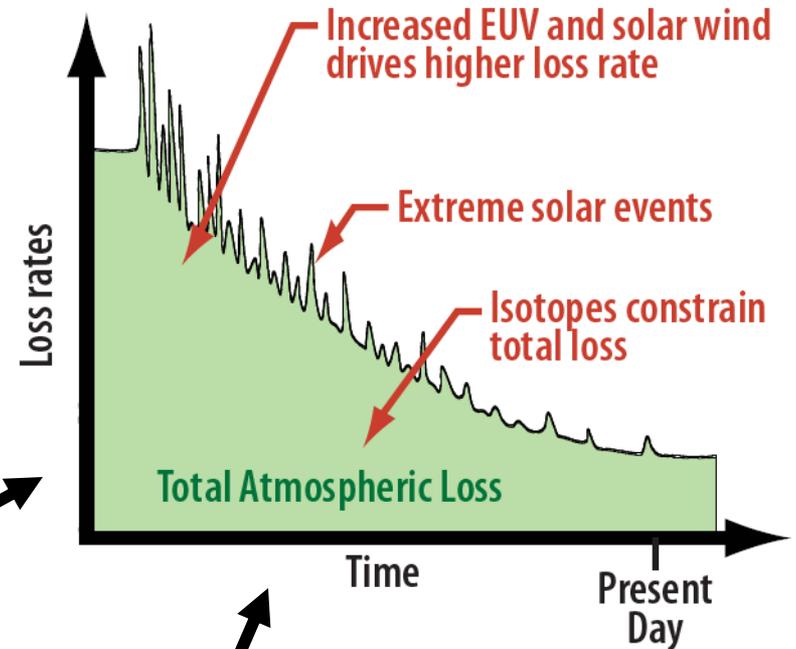
MAVEN's Timing in the Solar Cycle



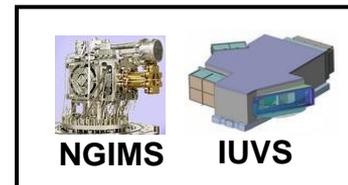
Constraining the Total Atmospheric Loss Through Time



History of Solar Activity



Physical & Empirical Models



NGIMS

IUVS

Isotope Ratios

We will use multiple, independent approaches to determining atmospheric loss.

Mission Operations at Lockheed Martin, Science Operations at CU/LASP



Lockheed Martin Mission Support Area



LASP MAVEN Science Operations Center

Proposal, Site Visit, and Presentation at NASA HQ



One Of ~220 Reviews Over The Life Cycle Of MAVEN



MAVEN Spacecraft Early In Assembly

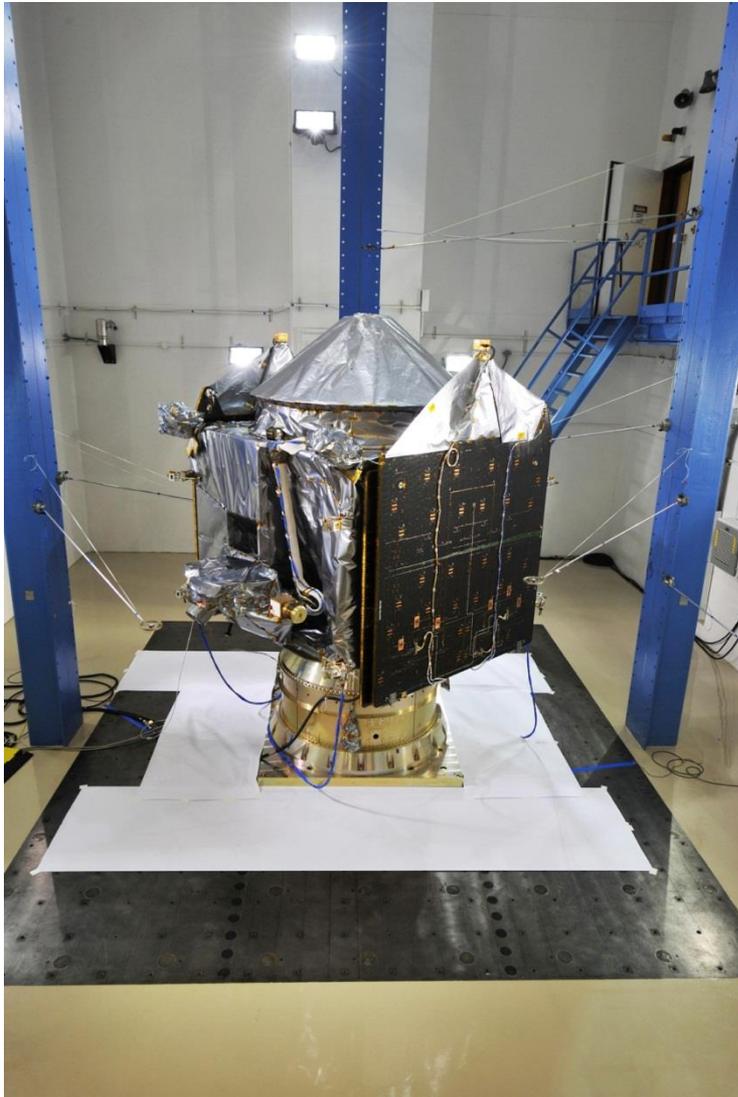


Integration of core structure with fuel tank

Nearly Complete Spacecraft In Lockheed Martin High-Bay Cleanroom



Observatory in Environmental Testing

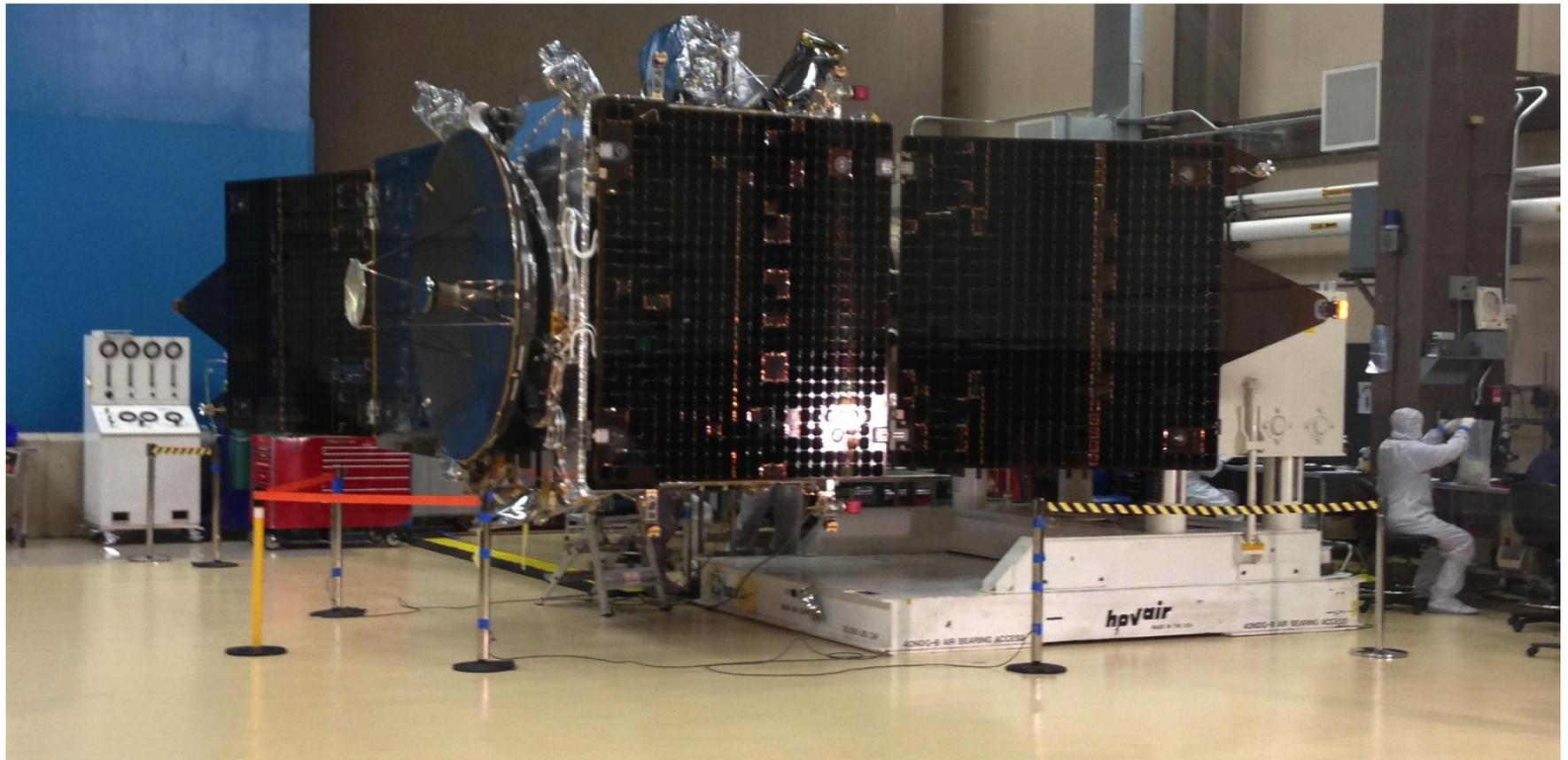


MAVEN in Acoustics



MAVEN on Shaker – Sine Vibration

MAVEN Observatory Ready To Ship



Starting Its Journey To Mars: From Lockheed Martin To Kennedy Space Center, 2 August 2013

Lockheed Martin



Buckley AFB, Colorado



Shuttle Landing Strip, KSC



PHSF, KSC



MAVEN's Atlas V – 401



Atlas 1st Stage



Ship to the Cape by barge

Atlas Centaur 2nd Stage



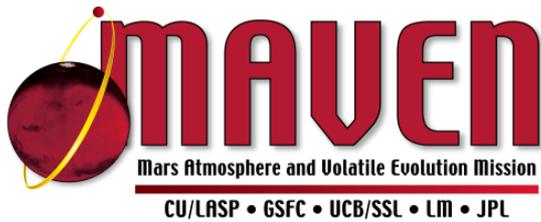
Atlas Payload Fairing



From Arrival At Cape To Launch

- ✓ Inspect, clean, and prepare spacecraft after shipping
- ✓ Re-install equipment that had been removed for shipping
- ✓ Re-install components that had been removed for minor rework or calibration
- ✓ Conduct System Verification Tests to ensure that everything works properly
 - Install pyro devices
 - Final spin balance test
 - Load fuel
 - Mate spacecraft to payload support structure that will attach to upper stage
 - Install spacecraft into payload fairing
 - Transport to Vertical Integration Facility (VIF) and mate with Atlas booster and Centaur upper stage
 - Roll out to launch pad (day before launch)
 - Fuel booster and upper stage (on launch pad on day of launch)
 - Final countdown and launch

Note: Launch is a major milestone in the project, but remember that the goal is the science!



MAVEN is on track, on schedule, and on budget.

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